ESPRESSO MAKING APPARATUS AND METHOD OF BREWING ESPRESSO

BACKGROUND OF THE INVENTION

RELATED APPLICATIONS

[0001] NONE

FIELD OF THE INVENTION

[0002] The present invention relates to an espresso making apparatus and a method for brewing espresso and more particularly to a mechanism for compacting a predetermined variable amount of ground coffee in a pressure chamber to facilitate the brewing of various sizes of espresso based beverages.

[0003] Espresso makers are known in the art and espresso makers for automatically brewing espresso are well known. Known prior art espresso makers for automatically brewing espresso are actuated by the user actuating a selector switch and a credit entering mechanism such as a coin receiver. The known automatic espresso makers utilize a piston which compresses ground coffee within a pressure chamber to compact the ground coffee a predetermined amount prior to passing pressurized hot water through the ground coffee to brew espresso. Known espresso making apparatus utilize a linkage to move the piston and piston rod in a reciprocating fashion within the pressure chamber as is illustrated in Figure 10. The linkage moves the piston in a fashion similar to the movement of a piston within a cylinder of an internal combustion engine to reduce the volume of the pressure chamber to a minimum predetermined volume (when the piston is fully extended into the pressure chamber as is illustrated in Figure 10(a)) and compact any ground coffee in the pressure chamber to the minimum volume. When espresso is to be brewed pressurized hot water is injected into the pressure chamber and it is desired to have the piston rod and linkage in line (see Figure 10(a)) to prevent movement of the piston to increase the volume of the pressure chamber when pressurized hot water is directed into the piston chamber. Aligning the piston rod and linkage, as is illustrated in Figure 10(a), allows the piston to resist the high pressure force of the pressurized hot water in the pressure chamber. If the linkage and piston rod are not in line (see Figure 10(b)), the pressure of the pressurized water can push the

piston and linkage to cause undesirable expansion of the pressure chamber when the espresso is being brewed as a result of the pressurized water being injected therein.

[0004] The use of a linkage and piston fixes the minimum volume of the pressure chamber to a fixed minimum volume when the piston and linkage are in line. Since the piston and linkage must be aligned to resist the force of the pressurized water, the piston and linkage must be moved to the same position each time to compact the coffee grounds in the pressure chamber. If different amounts of coffee grounds are present, the coffee grounds will be compacted to different degrees due to the fact that the volume of the pressure chamber will be reduced to a fixed minimum volume by movement of the piston irrespective of the volume of coffee grounds located in the pressure chamber, i.e., if an excessive amount of ground coffee is placed in the pressure chamber, the ground coffee will be compacted to a higher degree than if less coffee were placed in the pressure chamber. This results in a prior art machine which is capable of only brewing one size of espresso drink because the volume of the pressure chamber is constant and cannot be varied without varying the degree of compactness of the ground coffee. Also, in the prior art machines, the amount of coffee placed in the pressure chamber must be carefully controlled to maintain the correct amount of compaction of the ground coffee.

[0005] Accordingly, it is an object of the present invention to provide a new and improved espresso making apparatus and a method for brewing espresso which enable espresso drinks of various size to be automatically brewed from the same machine while maintaining a substantially uniform compactness of the ground coffee through which the pressurized hot water is passed to brew an espresso beverage.

BRIEF SUMMARY OF THE INVENTION

[0006] The present invention provides a new and improved espresso making apparatus which includes a supply of pressurized hot water, a pressure chamber for receiving a predetermined amount of ground coffee therein, a piston movable within the pressure chamber to compact the ground coffee, a cam, a motor for rotating the cam, a cam follower operatively associated with the piston for moving the piston in response to rotation of the cam, a sensor for sensing a parameter of the motor, a control for deenergizing the motor when the ground coffee in the pressure chamber is compressed a predetermined amount and the sensed motor parameter is equal to a predetermined

value, a fluid passageway for directing the supply of pressurized hot water through the compressed ground coffee in the pressure chamber to brew espresso and an outlet from the pressure chamber for directing the brewed espresso to a use location.

[0007] Still another provision of the present invention is to provide a new and improved espresso making apparatus including a supply of pressurized water, a pressure chamber for receiving a predetermined amount of ground coffee, a piston movable within the pressure chamber to compress the ground coffee, a motor for moving the piston, a sensor for sensing a parameter of the motor when the motor moves the piston, a control for denergizing the motor to stop movement of the piston when the ground coffee in the pressure chamber is compressed a predetermined amount and the sensed motor parameter is equal to a predetermined value, a fluid passageway for directing the supply of hot water through the compressed coffee in the pressure chamber to brew espresso and an outlet from the pressure chamber for directing the brewed espresso to a use location.

[0008] A further provision of the present invention is to provide a new and improved method of brewing espresso from a supply of pressurized hot water and ground coffee which has been compacted a predetermined amount by a motor which moves a piston to compact the ground coffee in a pressure chamber including the steps of providing a predetermined amount of ground coffee in the pressure chamber, energizing the motor, moving the piston within the pressure chamber to compact the ground coffee in response to energization of the motor, sensing a motor parameter of the motor while the motor moves the piston to compact the ground coffee in the pressure chamber and deenergizing the motor to stop movement of the piston when the sensed motor parameter is equal to a predetermined value and the ground coffee is compacted a predetermined amount in the pressure chamber.

[0009] The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of the disclosure. For a better understanding of the invention, its operating advantages and specific objects obtained by its use, reference is made to the accompanying examples, drawings and descriptive matter in which a preferred embodiment of the invention is illustrated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIGURE 1 is a schematic representation of an espresso maker constructed in accordance with the present invention.

[0011] FIGURE 2 is a fragmentary view of a portion of the espresso maker of Figure 1 illustrating the grinding of the coffee beans and the movement of the ground coffee into the pressure chamber.

[0012] FIGURE 3 is a fragmentary view similar to Figure 2 illustrating the initial rotation of the cam and initial movement of the piston toward the pressure chamber to compact the ground coffee.

[0013] FIGURE 4 is a fragmentary view similar to Figure 3 illustrating the cam rotated to a position in which the coffee in the pressure chamber is compressed a predetermined amount and wherein pressurized hot water is injected into the pressure chamber through the compressed coffee to brew espresso.

[0014] FIGURE 5 is a fragmentary view illustrating movement of the latch to its unlatched position to enable the lower piston to be moved to open the bottom of the pressure chamber.

[0015] FIGURE 6 is a fragmentary view illustrating movement of the lower piston to open the bottom of the pressure chamber.

[0016] FIGURE 7 illustrates further rotation of the cam and piston and expulsion of the ground coffee from which espresso has been brewed from the pressure chamber.

[0017] FIGURE 8 illustrates further rotation of the cam to return the cam to its initial standby position, closing of the bottom of the pressure chamber by the lower piston and movement of the upper piston to its initial standby position.

[0018] FIGURE 9 is a schematic illustration of the control for the motor.

[0019] FIGURE 10 is a schematic illustration of a prior art espresso maker which utilizes a piston and linkage assembly to compress the ground coffee where Figure 10(a) illustrates the piston rod and linkage in an in line position and Figure 10(b) illustrates the piston rod and linkage in a not in line position.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Referring to the figures and more particularly to Figure 1 an espresso making apparatus 5 is disclosed. The espresso maker 5 includes a coffee hopper 2 having coffee beans 4 stored therein and a coffee grinder 6 which is adapted to receive coffee

beans from the coffee hopper 2, grind the beans and deliver the ground coffee to a use location.

[0021] A pressure or brewing chamber 8 is located within the espresso making apparatus 5. The pressure chamber 8 includes a first or top opening 9 and a second or bottom opening 11, and is operable to receive the ground coffee therein as is more fully illustrated in Figure 2 wherein the coffee grinding mechanism 6 is moved to a position contiguous to the top opening 9 of the pressure chamber 8 to drop a predetermined amount of ground coffee therein. The amount of ground coffee deposited into the pressure chamber 8 is dependent upon the time period that the coffee grinder 6 is energized and the particular espresso drink to be brewed. After a predetermined amount of ground coffee is located within the pressure chamber 8, the pressure chamber 8 is closed by a piston 10 which compresses the ground coffee disposed within the pressure chamber 8 prior to hot water being passed through the compacted ground coffee in the pressure chamber 8 to brew espresso.

[0022] A water supply in the form of a water tank 12 is provided having a supply of water 14 for brewing espresso disposed therein. A pump 16 is adapted to pump water 14 from the supply 12 to a water heater or boiler 18 via fluid conduit 20. The boiler 18 heats the water 14 which is directed through a valve 22 to fluid conduit 24. Fluid conduit 24 is connected to the piston 10 which includes a fluid passageway 26 disposed therein. When the ground coffee in pressure chamber 8 is compacted a predetermined amount by piston 10, pump 16 is energized to pump pressurized water to boiler 18, boiler 18 heats the water and valve 22 is opened to provide for the passage of pressurized hot water from boiler 18 through fluid conduit 24 and passageway 26 and into the compacted coffee disposed within the pressure chamber 8. A passageway 30 is provided from pressure chamber 8 to direct the brewed espresso to a use location such as a container or cup 32. After the ground coffee in pressure chamber 8 is compacted a predetermined amount of pressurized hot water is directed through the fluid passageway 26 in piston 10 and through the compacted ground coffee in pressure chamber 8 to brew espresso which is then delivered through the passageway 30 to the cup 32.

[0023] The piston 10 includes a piston head 36 which is adapted to be received in the pressure chamber 8 to compress ground coffee disposed in the pressure chamber 8. An O-ring seal 37 is located on piston head 36 to establish a seal between the piston head

36 and pressure chamber 8. The piston 10 is supported on and is pivotable about shaft 38 and include a cam follower 40. A rotatable cam 42 is supported adjacent piston 10 and includes a cam surface 44 which is operable to engage with the cam follower 40 operatively associated with the piston 10 upon rotation of cam member 42. While the cam follower 40 is disclosed as a portion of piston 10, it should be apparent that the cam follower 40 may be a separate member which is operatively connected to piston 40 rather than integral therewith, as is illustrated, without departing from the scope of the present invention. A motor 46 is provided for effecting rotation of cam member 42. Conductors 48 are provided to connect the motor 40 to a source of power in a well known manner. A control 50 is associated with conductors 48 to sense a motor parameter of motor 46 which is used to control energization of the motor 46. Example of motor parameters which could be sensed include current, voltage and/or torque.

[0024] When it is desired to brew espresso, a predetermined amount of ground coffee is deposited into the coffee grinder 6 which grinds the coffee and deposits the ground coffee into the pressure chamber 8, as is illustrated in Figures 2 and 3. After the ground coffee is located in the pressure chamber 8 and the coffee grinder 6 is retracted to its full line position illustrated in Figure 3, motor 46 is energized to rotate cam member 42. As cam member 42 rotates, cam surface 44 engages with the cam follower 40 on piston 10 and effects pivotable movement of the piston 10 about shaft 38 in a clockwise direction as is viewed in Figure 3. Continued energization of motor 46 causes the cam member 42 to continue to rotate until the ground coffee in pressure chamber 8 is compressed a predetermined amount as is illustrated in Figure 4. The resistance of piston 10 to further compressive movement by rotation of cam member 42 increases as the ground coffee in pressure chamber 8 is compressed. The increased resistance to motor movement is reflected in a change in a motor parameter associated with the motor 46 which is sensed by the control 50.

[0025] In one embodiment of the invention as is disclosed in Figure 9, control 50 senses the motor current of motor 46 as motor rotates cam 42 and piston 10 compresses the ground coffee in pressure chamber 8. The motor current increases as the motor meets increased resistance to movement as piston 10 compresses the ground coffee in pressure chamber 8. The control 50 includes conductor 48 on which input power is supplied and directed to the motor 46. A resistor R2 is connected to the input 48 of

motor 46 and establishes a signal on line 60 which is directly related to the motor current of motor 46. The signal on line 60 is directed through resistor R1 and across compositor C1 to an input 2 of an integrated circuit 62. The integrated circuit 62 is schematically illustrated in phantom lines in Figure 9 and includes inputs/outputs 1, 2, 3, 4, 5, 6, 7, and 8. The signal applied on line 60 to input 2 of the integrated circuit 62 is a signal indicative of the motor current of motor 46 which is directly related to the resistance to movement of motor 46 and the degree of compactness of the ground coffee in pressure chamber 8. The input 3 to the integrated circuit 62 is controlled by a trimmer resistor R3 which sets a reference signal on the input 3 to the integrated circuit 62 when the reference signal set by trimmer resistor R3 on input 3 exceeds the feedback signal at input 2 on line 60 an output will be established at the output 7 of the integrated circuit to effect the energization of motor 46. The trimmer resistor R3 sets a reference signal which controls the amount of compression of the ground coffee in pressure chamber 8 and the maximum motor voltage. When the maximum motor current is exceeded, the control 50 operates the deenergize motor 46. When the reference current signal on input 3 is exceeded by the current signal fed back on line 60 an output signal is established on output 7 which is directed through resistors R4 and R5 to transistor Q1. The output at 7 of the integrated circuit causes transistor Q1 to conduct which energizes the coil of relay 70 to move relay context 72 from its full line position shown in Figure 9 to its phantom line position shown in Figure 9 in which it deenergizes motor 46. Relay 70 continues to hold context 72 in its phantom line position until the entire control is deenergized. A resistor R6, zenor diode Z1 and capacitor C2 are connected to the input 48 to the control 50 to filter the incoming power from the source of power to control 50.

[0026] As the motor 46 rotates cam 42 and as piston 10 compresses coffee grounds in chamber 8, the motor current increases until the ground coffee is compacted a predetermined amount at which time the current sensed by R2 on line 60 is equal to a preset value of current at terminal 3 which is related to the amount of compression of the coffee grounds in pressure chamber 8. Thus, motor 46 rotates cam 42 to compress the ground coffee in pressure chamber 8 a predetermined amount which is related to a motor parameter such as motor current. It has been found that it is desirable to compress the ground coffee to approximately 22.5kg/cm^2 which has been found to equate to a motor current of 3 amps in the present embodiment. Accordingly, a

reference valve of 3 amps is set at reference input 3 by trimming resistor R3 and motor 46 is deenergized when the sensed motor current equals 3 amps.

[0027] Other motor parameters such as voltage or torque could be sensed to control the amount of compression of the ground coffee in pressure chamber 8 and to deenergize motor 46 when the ground coffee is compressed a predetermined amount. The motor 46 will compress the ground coffee in pressure chamber 8 until the control senses that the motor parameter equal to a preset value. Motor parameters which are related to the amount of compression of the ground coffee in pressure chamber 8 include current, voltage and/or torque.

[0028] The stopping of motor 46 and movement of piston 10 can be at different locations depending upon the amount of ground coffee placed in pressure chamber 8. This enables the espresso maker 10 to produce espresso drinks of different sizes and requiring different amounts of ground coffee and to compact all of the different amounts of ground coffee the same amount. For example, one ounce or four ounces of ground coffee can be placed in pressure chamber 8 and compressed by the piston 10 and the motor 46 and control 50 will function to ensure that the one ounce of coffee is compacted to the same degree to which the four ounces of coffee is compacted. The amount of compactness can be controlled by setting a reference or trip value for the current at input 3 of the integrated circuit 62 which deenergizes motor 46 when the motor current reaches the reference valve. The ground coffee must be compacted prior to passing pressurized hot water through the coffee grounds to brew espresso. The amount of compression of the ground coffee is important and can be preset by utilizing a motor parameter such as current, voltage or torque to deenergize motor 46 and stop rotation of cam 42 when the ground coffee in pressure chamber 8 is compacted a predetermined amount. It has been found that motor voltage and motor torque are also directly related to the amount of compression of the ground coffee in the pressure chamber. As the compression increases as cam 42 continues to rotate and piston 10 continues to move into pressure chamber 8, the motor voltage increase as does the motor torque and current. Torque or voltage control could also be utilized to effect deenergization of motor 46 to control the amount of compression of the ground coffee in pressure chamber 8.

[0029] After cam 42 is rotated to its position illustrated in Figure 4, the ground coffee in pressure chamber 8 is correctly compacted and hot pressurized water 14 is directed from the water supply 12 through conduit 20 where it is heated in boiler 18. After the water is heated in boiler 18, valve 22 is opened to pass the pressurized hot water 14 through conduit 24 and through the fluid passageway 26 disposed in piston 10. The pressurized hot water then exits from fluid passageway 26 and passes through the compacted coffee grounds in pressure chamber 8 to brew espresso and passes through the outlet 30 where it is collected in a container 32.

[0030] After espresso is brewed from the coffee grounds in pressure chamber 8, it is necessary to remove the compacted used coffee grounds from pressure chamber 8. The second or bottom opening 11 in pressure chamber 8 is normally closed by a lower piston 54 which includes an O-ring seal 56 disposed on piston head 57. When lower piston 54 is in its position illustrated in Figure 1, the piston head 57 and O-ring 56 seal the lower opening 11 in pressure chamber 8. A latch member 52 is provided for latching the lower piston 54 in its closed position as is illustrated in Figure 1. When piston 54 is in its closed position and latch 52 is locked, pressurized water introduced into pressure chamber 8 will not move piston 54 to unseal opening 11.

[0031] When it is desired to expel used coffee grounds from pressure chamber 8, latch member 52 is unlatched and moved to its position illustrated in Figure 5 which allows lower piston 54 to pivot about shaft 38 in a clockwise direction from its position illustrated in Figure 5 to its position illustrated in Figure 6. When latch 52 is opened and piston 54 moves to its position illustrated in Figure 6, motor 46 is energized to continue rotation of cam member 42 in a clockwise direction which continues movement of piston 10 in a clockwise direction about shaft 38 to push the compressed used ground coffee from opening 11 in the pressure chamber 8 to clean pressure chamber 8 for the next brewing cycle. As is illustrated in Figure 7, if desired, a small blast of pressurized water may be expelled from fluid passageway 26 in piston 10 to assist in the expulsion of the used coffee grounds from pressure chamber 8 and to ensure that the coffee grounds do not stick to the piston 10.

[0032] After the ground coffee is expelled from pressure chamber 8, motor 46 continues to rotate cam 42 to its standby position illustrated in Figures 1 and 8 in which cam member 42 no longer biases piston 10. A suitable return spring, not illustrated,

interconnects shaft 38 and piston 10 and biases piston 10 in a counterclockwise direction about shaft 38 to its standby position illustrated in Figures 1 and 8. Piston 10 is operatively connected with lower piston 54 so that when the return spring bias piston 10 to its standby position, movement of piston 10 to its standby position also effects movement of piston 54 in a counter clockwise direction about shaft 38 to return piston 54 to its position in which piston 54 closes the bottom of pressure chamber 8. After lower piston is moved to its position in which it closes the bottom opening 11 of the pressure chamber 8, latch member 52 is moved to its locked or latched position shown in phantom lines in Figure 8 to lock piston 54 in its position in which it seals the lower opening 11 of the pressure chamber 8. A solenoid, not illustrated, can be used to move latch 52 between its latched and unlatched positions. The espresso making apparatus is now in condition to brew another espresso beverage.

[0033] It should be appreciated that control 50 can also control pump 16, energization of boiler 18, valve 22 and movement of coffee grinder 6 to grind and deposit ground coffee in pressure chamber 8. In addition, the control can be connected to a credit/selection mechanism, not illustrated, which can provide for payment and selection of the espresso drink to be brewed. Because a cam 42 member is used to position piston 10 various sized espresso drinks can be brewed as opposed to prior art automatic espresso brewers which only brew a single sized espresso drink.

[0034] From the foregoing, it should be appreciated that a new and improved espresso making apparatus 5 and method of brewing espresso has been disclosed. The espresso maker 10 includes a supply 12 of water 14 which is pressurized by a pump 16 and heated by a boiler 18. A pressure chamber 8 is adapted to receive a predetermined amount of ground coffee from a coffee hopper 4 and coffee grinder 6. A piston 10 is movable within the pressure chamber 8 to compress the ground coffee and a motor 46 rotates cam 42 which engages with a cam follower 40 disposed on the piston 10 to move piston 10 to compress the ground coffee located within the pressure chamber 8. A control 50 senses a parameter of the motor 46 such as current or voltage when the motor 46 rotates cam 42 which moves the piston 10 to compress the ground coffee. The control 50 deenergizes the motor 46 to stop movement of the piston 10 when the ground coffee in the pressure chamber 8 is compressed a predetermined amount which is related to the motor parameter. A conduit 24 is provided for directing the supply of

pressurized hot water through the compressed ground coffee in the pressure chamber 8 to brew espresso and an outlet 30 is provided from the pressure chamber 8 for directing the brewed espresso to a use location such as a cup 32. The method of brewing espresso using the disclosed apparatus includes the steps of providing a predetermined amount of ground coffee in the pressure chamber 8, energizing the motor 46, moving the piston 10 within the pressure chamber 8 in response to energization of the motor 46 to compact the ground coffee, sensing a motor parameter such as current or voltage and deenergizing the motor 46 to stop movement of the piston 8 when the sensed motor parameter is equal to a predetermined value and the ground coffee is compacted a predetermined amount.